SCIENCE

VOL. 79 FRIDAY, JUNE 8, 1934 No. 2058

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

CHARLES PROTEUS STEINMETZ AND THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS[1]

By DUGALD C. JACKSON

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THIS is the anniversary of Dr. Steinmetz's birth. He was born on April 9, 1865. In later years he was my friend, as he was also of many of you who are here to-night.

Also, about this time in the month of April fifty years ago the first formal movement was made in New York for establishing the American Institute of Electrical Engineers. It was my good fortune to attend in Philadelphia a few months later its first formal meeting for the reading of papers, although I was then still an undergraduate in Pennsylvania State College. The meeting was held in Philadelphia on account of an electrical exhibition being supported there under the auspices of the then sixty-years-old Franklin Institute.

I have been asked to speak for both of these, to us, important anniversaries. With respect to the American Institute of Electrical Engineers, I am requested to provide some words additionally on why and under what circumstances the Institute proves of value to the young men who have ambitions in the field of electrical engineering.

I remember well the joint Pittsfield and Schenectady meeting of the American Institute of Electrical Engineers, held in February, 1911, when I was president of the Institute. Steinmetz had been president nine years earlier; but he was actively the

[1] Address at dinner at Schenectady, N. Y., held on the anniversary of Steinmetz's birthday and in celebration of fiftieth year of the American Institute of Electrical Engineers, April 9, 1934.

patron of that meeting of February, 1911, and he gave deep attention to according opportunities for the younger men to enter the discussions as well as personally encouraging them to do so. I have hanging in my office at M. I. T. a picture of that meeting, taken on a wintry porch either here or at Pittsfield, in which Dr. Steinmetz makes a striking figure near the center of the front row. It may help you to fix your electrical engineering chronology for me to say that in that same year I had the pleasure of presiding in Pittsfield at a dinner in celebration of the twenty-fifth anniversary of Stanley's production of his transformer. I still retain on my desk a small replica of that transformer, then presented to me.

Steinmetz was a man who partook of the meat and honey of rigorous thinking and hoped that others might do so. Any man who occupied himself primarily with affairs inadequate to his ability made proof to Steinmetz of an inappropriately tuned mind but which mind might perhaps still be brought into harmony; and Steinmetz therefore was constantly encouraging the young men around him to lift the level of their ambitions and to cultivate real achievements. To make a capable engineer, a capable scientist or a capable inventor a man needs at least two or more of the following qualities: (1) Discriminating mathematical (*i.e.*, analytical) powers with which to conduct exploration; (2) imagination for arousing vision of a promised land; (3) curiosity for inciting experimentation; (4) penetrating powers for observing results of analysis or experiments; (5) synthetic intelligence to support invention. Steinmetz possessed all these qualities and added thereto a warm sympathy toward those in the stream who were struggling in the current toward achievement, and also toward any unfortunates who had slipped into the backwash of misfortune or who had never known the opportunity of achieving.

This quality of sympathy, which was added to his gift of clear thinking and lucid expression, made for him many admirers and followers who otherwise might not have thought about him. In his later years he strove to bring people to a sense of cooperation which would lead to full mutual welfare, as the contests between selfish pride of station and unselfish but superficially sentimental social attitudes cause turmoil which in his opinion prevent sound social processes from becoming firmly seated. I will have to confess that it requires a nice balance—this relation between individual liberty on the one side and the individual restraints that are necessary to assure fullest mutual welfare on the other side, and the balance is as yet to be discovered. Republicanism calls for unity, not for uniformity. The unity in this case is a unity of purpose, whether determined by some select class, as in ancient republics such as the Republic of Rome, or by a complete democracy of the sane and mature citizens, as in modern states like the United States, Great Britain and France. Unity of purpose in the latter situation relates to the mutual interest and welfare of all classes of citizens; but there may be wide differences of opinion regarding the best ways of accomplishing the purposeful end, and much argumentative controversy may stand in the way of progress.

It was not Fortune that made Steinmetz. The only time that I think of in which Fortune directed Steinmetz's life was when authorities of Germany declared his activities to be obnoxious and he fled to America at the age of 24, to fall into the sympathetic hands of Mr. Eickemeyer. Each following part in the pattern of his life came into its place as a consequence of his own intellect and industry. Steinmetz came to America at a period when the productiveness of processes and machines was establishing for itself a strong part in the support of man, in supplement to the old-time productiveness of the earth, its waters and its atmosphere. He did not fail to embrace the opportunity of his period. He promptly exhibited his ability as an original and resourceful experimenter by publishing his results on hysteresis phenomena, and shortly thereafter showed his analytical grasp by demonstrating the usefulness of algebra of complex quantities in electric circuit computations. These were but incidents in a life of steadily growing fruitfulness.

Lord Avebury tells of an inscription not less than 5,800 years old in which the floor of heaven is described as made of iron. This is an interesting change of emphasis from the pearly gates and golden streets of modern evangelists, but it is not a greater shift than the changes in human relations in the same period, which have been made for the good of civilization by scientific discovery and invention. "Tiny scales make the great skin of the dragon," says a Chinese proverb, and we have the collective influences of successive discoveries and inventions which together make the great body of engineering that has lifted the human race out of a depth of degradation and misery that none of us here can easily conceive, so that we now (even at our worst) are all in relatively considerable ease. In spite of this achievement in favor of humanity, engineering (as an embodiment of science and invention) has to align its path of further progress with solicitude so as to avoid the evil anticipations of the Cassandras and also to still the lamentations over the past of the Jeremiahs.

Scientific observation, discovery and invention forerun social organization; simple social organization foreruns organized government; but organized government then becomes necessary to maintain justice between man and man, ensure domestic tranquillity, provide for the common defense, promote the general good, secure general liberty (I paraphrase a well-

familiar definition). The existence of organized government connotes regulations or laws, and the object of governmental laws is to assure that human beings may live in propinquity and agree together without the old-time history-long recourse to bludgeon, dagger or gun. However, neither justice, domestic tranquillity, mutual defense, common good nor general liberty can be assured when depth of poverty and misery strikes at the greater portion of the population of a nation. If you wish to know a little of depths of poverty which in actuality are beyond your evilest dreams, I commend you to the reading of Kipling's book called "Kim," which treats in part of the life of the natives in Northern India with its immeasurable poverty and attending lawlessness of the many contrasted with the inordinate power and wealth of a few, or Mrs. Buck's book called "Good Earth," which deals with the misery of the simple farmer and the contrasts of life on the fertile plains of China. The contrasts between wealth of the high and misery of the lowly which are described in those books seem to me no greater (and perhaps they are not so great) than the like contrasts that were observable in the European hemisphere three centuries ago, which was before the influence of scientific discovery and invention began to be felt in the lives of western men through the effects of machines and manufactured products that leveled up in large degree the living conditions of the lowest coteries of population without so large a proportional influence on the state of the wealthy. This influence is yet but little felt in the plains of India, except for the effect of rail transportation in suppressing famine; and the influence is felt in China only on the eastern edge of its great area. Those who have argued themselves into believing that the present period is a "sunk epoch" for us of the western world have merely failed to observe the facts accurately. Much that has been written as a comparative condemnation of our present modes of life is as shot full of error as would be a book on details of the "machine age" written by a man who was so ignorant of those details that he did not know enough to diagnose a water-dripping kitchen faucet as indicating need for a new washer.

The world has not yet come of age. It is still in the fighting, hoodlum stage of youth. For illustration: It is less than 300 years since naval authorities of Great Britain arrogantly demanded that ships of all other nations should dip their flags when passing British naval vessels. It is less than 200 years since Britain alienated her American colonies by placing prohibitions on colonial manufacturing. It is less than 100 years since Great Britain claimed the right to arbitrarily stop and search on the high seas the naval vessels of other nations. It is only 20 years since the whole western world in an epidemic of rabies ravaged the area of Europe.

The conception of a community tendency among human beings, in the origin of a civilization, is a child of engineering; but the development of this child in the hands of the hoodlum human race has been a wildly unguided one. We engineers having provided by our observations and inventions the opportunity for propinquity, what are we as human beings going to do for the prevention of mental and physical frictions which grow out of mutual contacts of independent individuals, and how are we at the same time to successfully maintain the intellectual independence of the man units? The description of a corpse does not compose history; nor does unrestrained sentimentalism make a useful guide to the future. History as seen from our era is a surging flux of men's blood, and its recital must be strong with movements and passions. The future, however, must be foreseen with many of the passions held under restraint; because liberty, independence and freedom, in the political sense, are closely bound up with a skein of restraints on the individuals who compose any community of interest. Recently, for the American Association for the Advancement of Science, I made an address on the "Origins of Engineering." That subject is full of the romance of the transfer of physical labor from human shoulders and laying the same labor on machines, associated with an increase of emphasis on human intelligence in contrast with brutality; which transfer is still going on, and we are all profiting by it in the Western nations. This transfer and change of emphasis is bound up in the tale of the origins and growth of engineering. I would like to make an address for you on the services which engineering has performed in advancing civilization and improving the conveniences associated with living, and another one on the abuses of engineering which have been introduced by many betrayals at the hands of civilized men, but each one alone of these topics is too extensive for a dinner speech, and so I must refrain. Besides which, my allotted speech time, like a salted silver mine, is rapidly approaching exhaustion.

However, you now may be asking yourselves what all this has to do with the young men and the American Institute of Electrical Engineers. Good! A question asked of oneself calls for an answer from oneself, and you are bound to carry on; but I will intervene with some suggestions to help the process.

The engineers are responsible for most of the factors (other than preventive medicine) that have lifted conditions of living out of the slough in which those conditions still lay at the time of the Middle Ages. We, as engineers, have been responsible for the instruments that have performed the service and that

continue in performance. We have been primarily interested in the scientific and technical questions relating to the production arising from those instruments, but we have had little interest in the social organizations under our governments and have paid little attention to the ways in which our productions have been used. We are now under sharp criticism. Obviously, the criticism is justified, for we should recognize that we are under an obligation to give more attention to relations with our fellow men. Here is one of the greatest opportunities offered to you younger men by the American Institute of Electrical Engineers.

The call from the world is for you to become more than expert men of science and technicians, and to add to that important quality the equally important one of moulder of opinions and leader of men. You can find no better schooling for that end than comes from active participation in the meetings of the American Institute of Electrical Engineers, giving equal parts of your attention to its scientific and professional sessions and to its organization business. In those scientific meetings you meet your peers, who will not tolerate hazy thinking, and you will become habituated to applying sound processes of thought regarding your associations with your fellows and thus it may become easy for you to apply sound thought-processes equally to scientific and to social matters, unusual though the latter is for the majority of people; and you will thereby become influentially serviceable to your community. Moreover, through active relations with your peers you will have it borne in on you that abstract principle is no monopoly of one man or of one party, but (like abstract justice) principle is arrived at by the combined thought of the most earnest and judicial-minded. That it is arrived at by fair compromise between honest minds who are competent in sound thinking, you will discover if you will impartially participate in the meetings.

These things of the intellect that are so much a part in the making of an influential man of the world will come to you out of the activities which I am commending to you, while you are at the same time retaining and improving your scientific and technical capabilities through the association with men of like capabilities. These are the most broadening of experiences, and the young man who neglects such opportunities in order that he may live a hermit-like and unsociable life, or that he may associate with groups of foggy-minded men or men of lesser ability than his own, is sacrificing one of the major privileges of his early years of life. Moreover, a young man profits by such activities in a multiple proportion to the attention with which he regards them, always with the reservation that they come in importance after the duties which he is paid a salary to perform. The young man in the electrical engineering branch of work who carries on his part in the Institute, in all of its affairs—papers, discussions and business duties (including its finances)—doing so with due consideration of the limitations which nature imposes regarding his time and his physique, and who encourages others to likewise do their reasonable parts, finds in later years that the American Institute of Electrical Engineers has been one of the parents of his progress. It was in recognition of this last fact that Dr. Steinmetz constantly encouraged the younger men to take active part in affairs of the Institute.

In the preceding I have referred to section finances. Money and credit must continue as the attending handmaiden and intermediary of man's efforts to exchange his abilities, time and goods for elements which he expects to afford him profit or pleasure; and it is desirable for a young man to secure self-reliant responsibility by dealing with financial relations from which he himself receives no direct money compensation. Reliable management of the section finances affords the opportunity and experience. In all this we must also remember that the effectiveness of the territorial sections arises from the fact that they are a part of a great national professional organization; and it is desirable to play one's part in the national affair.

The Institute now has joined with other professional societies in the engineering field to establish what we call the Engineers' Council for Professional Development, and through this organization you will later find further opportunities for guiding your own development. You can not grow unless you have the *will* to develop, and then your development is in your own hands and will be successful if you are judicious in appraising yourselves.

Dr. Steinmetz is no longer with us. A life that is over, is over; but the influence of deeds of merit is permanent, and there are many of the established and older men among you who emulate Steinmetz in encouraging you young men to actively embrace your opportunities in the Schenectady section. Taken in the main, man is still a primitive. Perhaps he always will be, since each individual human being grows out of a child, and the life of each individual is short for formative influences to have a large effect unless they are energetically embraced. Thus it is that each one of you young men should try to make the most out of the opportunities which lie before you in the Schenectady section and (through it) in the national organization.

Some of the things, collateral to your specific scientific or commercial work, to which you younger men

should give a fair amount of rigorous thought are such as the following—I choose my illustrations from engineering, but take them from outside of electrical engineering so that we shall not fall into controversy over the suggestions:

The railroad is a contribution by engineering to civilization: but is it good to spend money to ship cream to Massachusetts from the middle west by railroad and thereby depress the price paid to New England farmers below the level of fair profit and without providing any offsetting advantage to urban consumers? Is it good to cross-ship cranberries from Cape Cod into Wisconsin, which is a cranberry producing state, and from Wisconsin eastward, with an excess of shipping cost to be absorbed by producers and consumers? Is the country being misled by the many times repeated statement that our tremendous expenditures for hard-surfaced roads are being made for the farmers' benefit; and even if it is "good politics" now, is it ethically right and for the general good to spend from ten thousand to thirty thousand dollars a mile for secondary highway networks when half the money might suitably service the particular purpose and *any* money for the purpose has to be raised by difficult taxation, either in the locality concerned or over the nation?

These are typical illustrations from the extraordinary range of eccentricities of commercial distribution and of expenditures for permanent plant which have arisen through uncontrolled and thoughtless use of the engineers' priceless gift to civilization of modern transportation. Substantially every other engineering contribution to civilization is similarly abused. These eccentricities produce annual wastes of man-hours and of money. Are they either good commerce in the long run or sound political economy? Do the people of the nation possess sufficient wealth to support thoughtless community waste? Can we introduce restraints into such activities sufficient to cure or ameliorate the wastes and yet not cause undesirable restraints on the cherished independence of the individual beings that compose the community?

Until we engineers as individuals and as civic groups can apply accurate and impartial thinking in reflecting over these and many similar questions which essentially relate to those engineering applications that influence convenience of life throughout the nation and profoundly affect the economic condition of the citizens, we still have some important feature lacking in our education. We must fill in this lack, but we must accomplish the purpose without deteriorating our greatness in engineering science and the arts. While trying to do this, we must not forget that the activities of the average professional reformer or unreflective enthusiast not infrequently are as inimical to the general community welfare as the activities of the average professional demagogue. The two persuasions therefore ought to receive equally exacting scrutiny before their measures are accepted or supported.

OBITUARY

HOWARD AYERS

THE passing of Dr. Howard Ayers last October has been noted already. Critical valuation of his contributions to the comparative morphology of some of the lower vertebrates may be left to those who work intensively in the field where he was a contributor and controversialist.

Some of us who worked with him in the laboratory day by day would like to testify to human values. Ayers possessed in marked degree a kind of spiritual intuition, which led him, after an hour in a laboratory full of students, to crook his finger at one, take him to his office for an hour and send him forth an enthusiast for biological investigation. No less a figure than Dr. Erwin F. Smith confessed to such inspiration in a first year of biology with Ayers. In the classroom, his uncanny ability to see in the subject under discussion just what phases had escaped the student and bring those points up for discussion was phrased in his characteristic way, "What do they take me for? Do they suppose I would waste my time asking a question which I thought they could answer? I ask questions to make men think."

His laboratory was a workshop which was almost entitled to the sign, "We Never Close." A graduate student who held the watch on him got the retort, "Young man, you belong here when you don't have to be elsewhere." Again, he called in a medical student—"Mr. M., I believe the Almighty put every man into the world for a purpose. If he finds out what that purpose is, he becomes useful and successful. He certainly did not intend you for a doctor."

Howard Ayers was not popular, but no man who came into intimate contact with his broad scholarship, his enthusiasm for work, his intolerance of sham or pretense, could fail to recognize his claim for leadership, based like that of the knights of old on being always a little the best man on the job. Such men went away from Ayers' laboratory better and more useful for the contact.

CHARLES THOM
C. M. JACKSON

RECENT DEATHS

DR. ALVAH HUNT DOTY, health officer of the Port of New York from 1895 to 1912, died on May 27 at the age of seventy-nine years.

DR. HERBERT CARL KASSNER, associate professor of analytical chemistry at the College of Pharmacy of Columbia University and a consultant in pharmaceutical chemistry, died on May 14. He was thirty-five years old.

DR. GEORGE F. STROHAVER, S.J., head of the department of chemistry and dean of the college of Arts and Sciences at Georgetown University, died on May 18. He was forty-eight years old.

LOUIS M. POTTER, general sales manager and vice-president of the Spencer Lens Company, died on April 26 while attending a meeting of the Book Committee of the Methodist Book Concern in Cincinnati. Mr. Potter had been associated with the Spencer Lens Company for more than twenty-five years.

PROFESSOR JAMES YOUNG SIMPSON, lecturer on natural science in the University of Edinburgh, died on May 21. He was sixty years old. Dr. Simpson delivered the Terry Lectures at Yale University in 1929.

Nature reports the death of Dr. Angel Gallardo, formerly Argentine Minister for Foreign Affairs, rector of the University of Buenos Aires since 1932, and president of the Academy of Sciences in Buenos Aires since 1927, aged sixty-six years.

SCIENTIFIC EVENTS

WORK IN PHYSICS OF THE BRITISH NATIONAL LABORATORY

THE annual report of the British National Physical Laboratory at Teddington has been issued. In a summary printed in the London *Times* it is recalled that the laboratory has grown in the course of 34 years to a large institution occupying 14 buildings in grounds of 50 acres. The staff of over 600 is engaged on the most varied research and test work in most branches of physics and engineering, and an exhaustive account of the work done in 1933 is given.

Some of the most valuable features of the laboratory, according to the *Times*, are its wind tunnels for aerodynamic research. The highest wind-speed available hitherto has been about 75 miles an hour, but in 1933 a tunnel with a wind-speed of 140 miles an hour was brought into use, and a similar tunnel is being constructed. These new tunnels are of the open jet type, *i.e.*, an object can be thrust from the surrounding still air into the center of the wind-stream. The air speed attainable in the new tunnels will be of great value in view of the constantly increasing speed of aircraft.

During the year the Radio Research Station at Slough has become part of the laboratory. The station equipped and took part in the Polar Year radio expedition which, under Professor E. V. Appleton, undertook ionospheric observations at Tromsö, in the north of Norway.

In the course of the year the department of physics investigated the method of reducing sound transmission between two rooms by a partition composed of two layers of material with an intervening air space. It was found that unless such a double panel was properly designed it might transmit more sound than one of its panels used alone.

The department of electricity is responsible for the maintenance of the ultimate electrical standards, a task involving great accuracy as on it depend charges running into many millions of pounds. Similarly the department of metrology is charged with the maintenance of the standards of length and mass. During the year it completed the task of measuring the yard and meter in terms of the wave-lengths of red cadmium light. The ideal of a standard of length which is an invariable physical constant has thus been realized. Over 16,000 taximeters used in London taxicabs were tested at the laboratory during the year owing to the increased initial fare.

The department of engineering made tests of cylinders for gas-propelled road vehicles. The department of metallurgy continued its research on dental amalgams with the object of finding a filling which will not expand with time.

The department of aerodynamics has carried out work on the spinning of aeroplanes, and the hope is confidently expressed that the difficulties in designing aeroplanes free from spinning troubles will soon disappear. There was a large increase in the number of ship models tested in the ship tanks for industrial firms during the year. Important results are said to have been made in the design of the smaller coast vessels.

THE DUTCH ELM DISEASE

IN less than a year the number of elm trees in this country found to have been infected with the Dutch elm disease has jumped from 10 to 1,480. During the last winter, scouts of the U. S. Department of Agriculture discovered more diseased elms than they found last summer, largely because systematic scouting did not begin until about September when a public works allotment was made available.

The area in which infection is most menacing in-

cludes the territory within a radius of 30 to 35 miles of New York harbor. How many more than 1,480 elms are infected will be brought out by further scouting by the Bureau of Entomology this spring and summer. Most of the diseased trees were found in New Jersey. In New York infected trees so far number more than 200. Only two have been discovered in Connecticut. More than 400,000 elms have been examined. When infection is found, the tree is destroyed.

At Cleveland and Cincinnati, where the first infected trees were found in 1930, it is hoped there are now no more cases of the disease. Only one infected elm was found last year and only nine in four years.

Not every sick elm has the Dutch elm disease, but elms with wilting, yellow or brown leaves, accompanied by brown streaks in the young wood, are under suspicion. If any elm has any of these symptoms, twigs which show the brown streaks should be sent at once to the newly established Dutch Elm Disease Laboratory, Room 207, Postoffice Building, Morristown, N. J. Small branches approximately ¾ inch in diameter and 6 inches long make a satisfactory sample. A statement of the exact location of the tree should accompany each sample.

If a clean cut is made across a twig affected with the Dutch elm disease, a brownish discoloration will be seen in the sapwood. In general the discolored tissue does not form a completely closed circle, but is made up of numerous small, brown dots. If the bark is peeled away and the sapwood exposed, the discoloration is evident as a series of short, brown streaks.

An insect, the smaller European bark beetle, probably spreads the disease from tree to tree but there may be other important ways of spreading it. If it were possible to eradicate either all the infected trees or all the bark beetles, the spread of infection might cease. The bark beetle, carrying spores of the disease, feeds preferably in the crotches of tender elm twigs. The fungus, as it grows, travels up and down the tree, probably reducing the sap flow through the affected parts. Eventually it kills the tree.

Once the tree is infected and begins to die, it forms a perfect nest for eggs of the beetles. The female, followed by the male, burrows under the bark for an inch or more, leaving dozens of eggs. The young beetles emerge contaminated with spores, and, feeding upon other parts of the tree or other trees, complete the cycle of infection.

Tree surgeons, park superintendents and tree lovers everywhere can help in combating this menace to America's finest shade trees by being on the lookout all summer for the wilting, yellow or brown leaves, accompanied by brown streaks in the young wood.

FOURTH FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

THE fourth Field Conference of Pennsylvania geologists was held at Pittsburgh on May 25, 26 and 27. About 75 geologists attended. Most of those present were from Pennsylvania, but representatives from New York, New Jersey and West Virginia also came. The University of Pittsburgh, the Carnegie Institute of Technology and the Gulf Companies acted as hosts to the conference, ably represented by the local committee consisting of Henry Leighton, *chairman*, M. G. Gulley, *secretary*, R. W. Clark, I. P. Tolmachoff, C. R. Fettke, W. A. Copeland and B. Perkins.

Following registration at the Carnegie Museum on the morning of May 25, parties were conducted through the museum by Messrs. Tolmachoff and Burke. In the afternoon a choice of either one of two field trips was offered. The first of these, led by R. E. Sherrill, visited localities in and about Pittsburgh. Many important physiographic features were observed, including "the Allegheny peneplane" and the abandoned and present valleys of the Monongahela River. Sections in the Conemaugh formation at and near Brilliant were visited, where not only the stratigraphic succession but some interesting structural features thought to be of landslide origin were observed. The other Friday afternoon excursion, under W. A. Copeland, consisted of a trip through one of the larger bituminous coal mines of the Pittsburgh district.

General trips for the entire conference were held on Saturday and Sunday. The Saturday trip, under C. R. Fettke, toured the area immediately west and northwest of Pittsburgh, during which representative strata of practically the entire Pennsylvanian system were seen. Of particular interest were the thin, fossiliferous, marine limestones which appear in this section. The party crossed the northeastern end of the McDonald oil pool, and the largest coal stripping operation in western Pennsylvania which is run by the Harmon Creek Coal Company, was observed south of Florence. Certain physiographic features were also pointed out. On the Sunday trip, which was led by Henry Leighton, various observations were made going south from Pittsburgh to Uniontown. At Uniontown the party turned east to examine the well-known section exposed along the National Pike where it crosses the Chestnut Ridge anticline. Here are exposed beds assigned to the Allegheny, Pottsville, Mauch Chunk, Greenbrier, Pocono, Loyalhanna and Chemung. Important structural features are also observable. Fossil collecting was indulged in at a large quarry in the Loyalhanna limestone on the east

limb of the fold. The trip ended at Ohiopyle, where the curious physiographic relations of the Youghiogheny River were observed. Exposures of the Allegheny series were seen. These rocks contain many plant impressions, and at one point a pothole six feet in diameter in them is exposed.

A complimentary smoker was given the conference by the Gulf Companies in their Pittsburgh laboratory on Friday evening, and the annual dinner was held at the Carnegie Inn on Saturday evening. During the smoker a short business session was held. It was unanimously voted to hold the 1935 meeting in or near Philadelphia since several invitations from geologists and institutions in that part of the state had been received. The advisability of holding the 1936 meeting jointly with the New York State Geological Association somewhere in the anthracite fields was favorably discussed, but no final action was taken.

BRADFORD WILLARD,
Secretary-treasurer

PARTICIPATION OF AMERICAN CHEMISTS IN THE NINTH INTERNATIONAL CONGRESS OF PURE AND APPLIED CHEMISTRY

THE Ninth International Congress of Pure and Applied Chemistry, the first world congress of chemistry to be held since that of New York in 1912, met at Madrid from April 5 to 11.

According to *Industrial and Engineering Chemistry,* from which the following facts are taken, the congress was a brilliant success. More than six hundred representatives, from some twenty-five countries, were in attendance with an equal number of chemists from Spain. The official delegation from the United States consisted of A. K. Balls, Edward Bartow, chairman, J. V. N. Dorr, Raleigh Gilchrist, L. W. Jones, G. N. Lewis, Atherton Seidell, Alexander Silverman, R. E. Swain and J. W. Turrentine. Harry N. Holmes and Burrows Morey were also officially delegated, but were unable to attend. Other American members in attendance included M. L. Crossley, R. K. Strong and A. Terry, Jr.

The provisions of the Spanish organizing committee for the scientific program were carefully made and the entertainment features and hospitality were lavish.

At the opening session the President of the Spanish Republic presided and the principal address was that by O. Ferandez, president of the congress, who spoke upon "The Evolution of Chemistry since the Last Congress in 1912."

There were four principal addresses.

G. B. Bonino, of Bologna, "The Raman Spectra and New Ideas upon the Constitution of Aromatic Nuclei."
R. Kuhn, of Heidelberg, "Flavine, a New Class of Natural Coloring Matters."
A. de Galvez-Cañero, of Madrid, "The Metallurgy of Silver and Mercury." A historical paper.
G. N. Lewis, of California, "Different Kinds of Water."

These were followed by twenty-one introductory addresses by leading chemists from all countries. In addition, some 250 papers were presented in the twelve different sections. Besides the introductory address on the isolation of the antineuritic vitamin, by Dr. Atherton Seidell, the following papers were presented by members of the American delegation:

Edward Bartow, "Glutamic Acid."
R. Gilchrist, "A New System of Analytical Chemistry for the Platinum Metals."
A. K. Balls and W. S. Hale, "Darkening of Apples."
J. V. N. Dorr, "Chemical and Mechanical Aspects of Sewage Disposal Practise."

Dr. P. Walden, who was present at the eighth International Congress of Pure and Applied Chemistry in Washington and New York in 1912, and who at that time was chosen president of the conference to be held in St. Petersburg, in 1915, was present at Madrid. He presided at the closing session of the congress.

The next meeting of the International Chemical Union, to which the United States may send fifteen delegates, will be held in Zurich during the summer of 1936, whereas the International Congress of Chemistry, to which American chemists are invited, will meet in Rome in 1938. The following officers were elected by the International Union: *President,* N. Parravano, Italy; *Vice-presidents,* Edward Bartow, United States; M. Bodenstein, Germany; M. F. Fichter, Switzerland; K. Matsubara, Japan; E. Moles, Spain. The holdovers are: M. Delépine, France; R. H. Kruyt, Netherlands; J. F. Thorpe, England.

The decoration of Commander of the Spanish Republic was bestowed upon one representative from each of eleven countries, one coming to Dr. Atherton Seidell for the United States. Representatives of ten different countries were made corresponding members of the Spanish Academy of Science. Among these were Professor Edward Bartow, of the State University of Iowa. Honorary degrees were conferred by the University of Madrid on eight individuals, one from each country, and in this group is Professor Gilbert N. Lewis, of the University of California.

Messrs. Bartow, Jones, Lewis, Silverman, Swain and Turrentine were members of the council of the union at the Madrid meeting.

During their stay in Madrid the American delegates were informally received by Ambassador Claude H. Bowers, and the American Club at Madrid gave a luncheon at which the Ambassador and the delegation were guests of honor. On this occasion Dr. Bartow

introduced the members of the delegation and J. V. N. Dorr and Robert E. Swain made brief addresses.

ENGINEERING AND AGRICULTURE AT THE BERKELEY MEETING OF THE AMERICAN ASSOCIATION

AT the meeting of the American Association for the Advancement of Science to be held in Berkeley from June 18 to 23, joint sessions will be sponsored by the Institute of the Aeronautical Sciences and the American Society of Mechanical Engineers. Cooperating with these groups are the Section of Hydrology of the American Geophysical Union, the Pacific Coast Section of the Society of Agricultural Engineers and the Western Inter-State Snow Survey Conference.

Subjects to be discussed will include various phases of fluid mechanics, structures of aircrafts, transport and management problems in aviation, engines and propellers. The meetings will cover three days, June 19, 20 and 21. At a dinner meeting on June 20, presentation of the Daniel Guggenheim Medal will be made by Major E. E. Aldrin, president of the Daniel Guggenheim Medal Fund.

With the exception of one session, all meetings will be held at the University of California. The section on engines and propellers will be held at Stanford University. The program also includes an inspection trip to Sunnyvale Air Base.

Institutions and organizations represented in the meetings by papers and discussions include: University of California; California Institute of Technology; Columbia University; United States Bureau of Agricultural Engineering; Byron-Jackson Company; Worthington Pump and Machinery Company; California Farm Bureau Federation; Oregon State Agricultural College; University of Illinois; Standard Oil Company; Pacific Gas and Electric Company; Stanford University; Douglas Aircraft Company; Sperry Products, Incorporated; University of Washington; Boeing School of Aeronautics; United States Navy; Townsend Corporation; Nevada Agricultural Experiment Station; Washington Water Power Company.

Plans have been made for a three-day conference on land-use planning with Dr. Laurence Dudley Stamp, of the University of London, director of the land utilization survey of Great Britain, as one of the principal speakers. Dr. Stamp will speak on the opening day of the conference on "Land Utilization Survey of Britain, Its Aims, Methods of Work and Progress, and the International Significance of Some of the Problems Involved."

Other speakers on the tentative program include: Dr. L. C. Gray, U. S. Department of Agriculture; President H. L. Shantz, of the University of Arizona; Dr. C. L. Alsberg, of Stanford University; Paul Eke, of the University of Idaho; Rex Willard, Washington State College, and a number of representatives of the University of California.

SCIENTIFIC NOTES AND NEWS

A MEMORIAL meeting in honor of the late Dr. William H. Welch will be held in connection with the Berkeley meeting of the American Association for the Advancement of Science. The principal address will be made by Dr. Ray Lyman Wilbur, president of Stanford University and formerly dean of its medical school. Dr. Welch was president of the association in 1906.

ON the occasion of the celebration of the sixty-ninth birthday of King George, the knighthood of the Order of the British Empire was conferred on Dr. Frederick Grant Banting, professor of medical research at the University of Toronto, and on Dr. Charles Edward Saunders, who served the Dominion Government for twenty years in the Experimental Farms Branch.

DR. HANS ZINSSER, professor of bacteriology and immunology at the Harvard Medical School, will go to the University of Paris for the second half of the academic year, 1934–35, as exchange professor from Harvard University. Dr. Jules Blache, professor of physical geography at the University of Grenoble, will be exchange professor from France at Harvard for either the first or the second half of the year.

THE University of Wisconsin will confer at commencement an honorary degree on Dr. Karl Taylor Compton, president of the Massachusetts Institute of Technology.

MCGILL UNIVERSITY conferred on May 29 the degree of doctor of laws on Dr. Frederick M. Becket, of New York, president of the Electro-Metallurgical Company and of the Union Carbide Company.

THE degree of doctor of science was conferred on May 16 by the University of Manchester on Dr. Archibald V. Hill, since 1926 Foulerton research professor of the Royal Society. Dr. Hill was formerly professor of physiology at the university.

THE doctorate of science was conferred upon Dr. R. B. Teusler, director of Saint Luke's International Medical Center, Tokyo, Japan, at the commencement exercises of the Medical College of Virginia on May 27. Dr. Teusler is an alumnus of the college.

A TESTIMONIAL dinner was given to Dr. A. A. Berg, surgeon of the Mount Sinai Hospital, on May 18 on the occasion of his retirement from the staff after serving for forty years. Dr. Berg plans to continue his private practise.

A COMPLIMENTARY dinner to R. H. Burne was held in London on May 10 on the occasion of his retirement from the physiological curatorship of the Museum of the Royal College of Surgeons of England after forty-two years in the service of the college. The chair was taken by Sir Holburt Waring, the president of the college, and among those present were Sir Cuthbert Wallace, Sir Arthur Keith, Sir Arthur Smith Woodward, Sir Peter Chalmers Mitchell, Dr. Tate Regan and Sir Buckston Browne.

DR. EDWARD W. SCRIPTURE, honorary professor of experimental phonetics at the University of Vienna, celebrated his seventieth birthday on May 21. Dr. Scripture was formerly assistant professor of psychology and director of the psychological laboratory at Yale University and from 1909 to 1914 associate in psychiatry at Columbia University.

Nature states that Professor Camille Sauvageau, professor of botany at the University of Bordeaux, and Professor G. Otto Rosenberg, professor of botany in the University of Stockholm, were elected foreign members of the Linnean Society at the meeting on May 10 to fill the vacancies caused by the deaths of Professor K. von Goebel and Dr. Erwin Baur.

PROFESSOR W. J. DAKIN, Challis professor of zoology in the University of Sydney, has been elected president of the Linnean Society of New South Wales.

DR. KARL HAUSHOFER, professor of geography in the University of Munich, has been elected president of the German Academy of that city.

DR. HAROLD C. UREY, professor of chemistry, has been appointed Ernest Kempton Adams research fellow for the second consecutive year by the trustees of Columbia University. The appointment is made annually from among distinguished physicists of the United States or of any foreign country. "The Fellow so appointed shall prosecute researches in the physical sciences or in their practical applications either in Columbia University or elsewhere. The results of such investigation shall be published and distributed by the university." The stipend is $1,250.

DR. JULIUS LIPS, formerly professor of sociology and ethnology at the University of Cologne, has been appointed visiting associate in anthropology for 1934–1935 at Columbia University.

THE executive board of trustees of the University of Pennsylvania has established a second professorship of medicine at the university and has elected Dr. O. H. Perry Pepper to that post, marking the first time since the School of Medicine was founded 169 years ago that provision has been made for more than one professorship of medicine. In addition the term of Dr. Alfred Stengel, the present professor of medicine, was extended by the board for three more years, although Dr. Stengel has reached the age of retirement after serving on the faculty of the school for forty-one years. Dr. Pepper, who is a brother of Dr. William Pepper, dean of the School of Medicine, is the third member of his family to be elected professor of medicine at the university. His grandfather, who was Dr. William Pepper, held that position from 1860 to 1864, and his father, Dr. William Pepper, who died in 1898, was also professor of medicine for a number of years as well as provost of the university.

THE J. T. Baker Chemical Company research fellowship in analytical chemistry (Eastern Division) for 1934–1935 has been awarded to Edward J. Nolan, who will work on the quantitative determination of zirconium under the direction of Professor W. C. Schumb at the Massachusetts Institute of Technology.

AT the forty-second annual meeting of the Anatomische Gesellschaft, which was held in Wurzburg from April 24 to 27, the following were elected presiding officers to serve until 1938: A. Benninghoff, Kiel; R. G. Harrison, Yale University; Th. Huzella, Budapest, and H. Stieve, Halle.

A WIRELESS dispatch to *The New York Times* states that Professor Julius Tandler, professor of anatomy at the University of Vienna, and city councillor, who was in China when the fighting broke out in Vienna, and who was arrested when he returned to Austria, has received an invitation from New York University to give a course of lectures. Professor Tandler was released from prison five weeks ago. He will later lecture at the National University in Shanghai, returning to the United States before sailing for Austria.

DR. JOYCE C. STEARNS, of the University of Denver; Dr. R. D. Bennett, of the Massachusetts Institute of Technology, and Dr. Darol K. Bowman, of Macdonald College, Canada, working in cooperation with Dr. A. H. Compton, of the University of Chicago, will again use Mount Evans as a laboratory this summer in a study of the nature and properties of cosmic rays.

PROFESSOR T. D. A. COCKERELL, of the University of Colorado, expects to work from June 15 to July 15 at the Citrus Experiment Station of the University of California.

DR. TETUO TOMIYAMA, assistant professor of biochemistry at the Imperial Fisheries Institute, Tokyo,

Japan, recently arrived in Berkeley to spend a year in research work with Professor C. L. A. Schmidt, chairman of the department of biochemistry at the University of California.

DR. EDMUND V. COWDRY, professor of cytology at the School of Medicine, Washington University, delivered the first annual Harry Hayward Charlton Memorial Lecture in anatomy at the University of Missouri Medical School on May 21. Dr. Cowdry spoke on "The Significance of Nuclear Changes in Virus Diseases."

DR. EDWIN GRANT CONKLIN, of Princeton University, on May 24 gave an illustrated lecture on "Recent Advances in the Study of Evolution" before the Ohio State University Chapter of the Sigma Xi Society.

DR. SELIG HECHT, of Columbia University, recently delivered a series of lectures on "The Retinal Mechanism for Vision" at the University of Minnesota. His lectures were sponsored by the department of zoology.

DR. G. W. STEWART, head of the department of physics at the State University of Iowa, delivered on May 23 an address on "The Mind's Trail in Scientific Discovery" at Morningside College, Sioux City, Iowa. Professor Stewart spoke under the auspices of the Morningside Chapter of Sigma Pi Sigma, honorary physics fraternity, into which he was initiated as an honorary member.

DR. C. E. MCCLUNG, of the University of Pennsylvania, visiting professor at Keio Medical College, Tokyo, was speaker at the annual meeting of the Sigma Xi Club of Peking on March 23. His lecture was entitled "Developments in Research in America." The following officers were elected for the ensuing year: *President,* Dr. C. W. Luh, of Yenching University; *Vice-president,* Dr. C. M. Van Allen, of Peiping Union Medical College, and *Secretary,* Dr. Adam P. T. Sah, of Tsinghua University. The Peiping club has fifty members. Guests present included Dr. A. Russel Moore, of the University of Oregon, and Dr. H. Irene Corey, of the University of Pennsylvania.

ACCORDING to *Nature,* the Abbé Henri Breuil, who recently was elected president of the Prehistoric Society of East Anglia for 1934, gave an address at the meeting of the society on May 23 on "Engraved and Sculptural Stone Monuments in the British Isles of the Transition Period between the Stone and Bronze Ages."

DR. ERIC PONDER, professor of general physiology at New York University, has been appointed investigator in general physiology at the Biological Laboratory of the Long Island Biological Association at Cold Spring Harbor, New York. The appointment will take effect in September. In the meanwhile Professor Ponder will establish his laboratory and conduct research in the George Lane Nichols Memorial building. He will give instruction in the summer course in general physiology at the laboratory together with Professor Ivon R. Taylor, of Brown University; Professor Kenneth S. Cole and Dr. Harold A. Abramson, of the College of Physicians and Surgeons, and Dr. Hugo Fricke, of the Biological Laboratory. A correspondent writes that "Dr. Ponder's appointment to the staff is a further significant step in fulfillment of the laboratory's policy of engaging in all-year research and in fostering that type of biological research sometimes referred to as quantitative biology, the laboratory's interest in which was so clearly demonstrated in the establishment, in 1928, of a laboratory for biophysics under the leadership of Dr. Hugo Fricke, and in the opening last year of the Cold Spring Harbor Symposia in Quantitative Biology. Dr. Ponder's coming to Cold Spring Harbor will make more practicable certain cooperative researches which he and Dr. Fricke have been conducting for some time concerning haemolysis. At the same time both men will continue independent studies in their respective fields." Dr. Ponder will be assisted in his work at the laboratory by John MacLeod, who has worked with him for several years.

THE eighth International Congress of Industrial Psychology will be held next September in Prague. This congress, originally planned for Vienna, has had to be twice postponed on account of difficulties in the international political situation. American psychologists who expect to be in Europe next September should consult Dr. W. V. Bingham at 29 West Thirty-ninth Street, New York, regarding precise dates and arrangements for the congress.

IT is planned to hold in Leningrad in 1936 a world conference of authorities on the stratosphere. It will be arranged to coincide with a total eclipse of the sun, which is the most advantageous time to study the upper layers of the atmosphere.

THE annual meetings of the American Society of Zoologists will be held at the University of Pittsburgh on Thursday, Friday and Saturday, December 27, 28 and 29. A symposium on mitosis will be held, probably on Thursday afternoon. This will be led by Dr. Franz Schrader, of Columbia University; Dr. Gerhard Fankhauser, of Princeton University; Dr. A. F. Huettner, of New York University, and Dr. C. W. Metz, of the Johns Hopkins University. The annual dinner will be held on Friday evening.

AN advisory committee composed of distinguished engineers and industrialists of the Eleventh National Power Exposition, to be held from December 3 to 8, at

Grand Central Palace, New York, has been announced. The chairman will be Irving E. Moultrop. Other members are: Homer Addams, past president, American Society of Heating and Ventilating Engineers; N. A. Carle, manager, Puget Sound Bridge and Dredging Company; Paul Doty, president, The American Society of Mechanical Engineers; Fred Felderman, past-national president, National Association of Power Engineers; Charles V. Haynes, president, American Society of Heating and Ventilating Engineers; C. F. Hirshfeld, chief, research department, Detroit Edison Company; O. P. Hood, chief mechanical engineer, U. S. Bureau of Mines; John H. Lawrence, Thomas E. Murray Company; Fred R. Low, past president, The American Society of Mechanical Engineers; David Moffat Myers, consulting engineer, and Fred W. Payne and Charles F. Roth, co-managers, of the exposition.

DISCUSSION

THE USE OF PERMANENT PAPER IN SCHOLARLY PUBLISHING

ONE of the major problems which confront librarians and the publishers of scholarly works is that of the deterioration of the paper upon which the publications are printed.

At the University of California Press we believe we have solved this problem by printing a special edition of 25 copies of our scientific works on a permanent, 100 per cent. rag paper, and distributing these copies to a selected list of depositories throughout the world.

Much of the material published by this press is in serial form. It is extremely technical and, we think, important within its field. Some 30 series are more or less regularly issued, relating to many fields of human knowledge from agricultural sciences and anatomy to Semitic philology and zoology. How much of this material possesses lasting value no one can say, but certainly some part of it will be of signal importance to future scholars.

Publishers have a duty to posterity; particularly those who, like ourselves, are engaged in preserving the results of original research. Consciousness of this ought to compel us to print our publications on material that will last. But much intervenes between duty and practise, and, as a result, important discoveries are being published so shoddily that within the century their record will be lost.

Late in 1933 the University of California Press, recognizing its obligation to future scholars, initiated the new method of publishing which has been described. Long study and careful preparation were necessary before the project could be successful. Paper technicians, chemists and other experts were consulted in an endeavor to prepare specifications for a paper which would be as permanent as possible without being excessive in cost. After much work on this problem, we found that in all probability our wisest course would be to adopt the specifications used by the United States Government Printing Office in the purchase of paper for the Federal Government's permanent printed records. These specifications are a matter of public record, and the paper mills are familiar with them; therefore no difficulty was encountered in having a shipment made up for our use. The comparatively heavy cost of this paper made its use impossible for entire editions, but its use in twenty-five copies made little difference. The bulk of the edition is printed on a paper of good quality but much less costly.

Once the technical problem of production had been solved, it was necessary to select a group of depositories for receiving the special copies. Consultation with scholars and librarians resulted in the compilation of a list of institutions throughout the world. In making the list, consideration was given to geographical distribution, to the scholarly nature of the libraries and to their willingness to bind and house the material which they would receive. Nothing was asked in return except their custodianship. If exchanges were forthcoming, so much the better, but they were not requested. (Should any reader wish a list of these libraries, it will be gladly furnished on application to the author of this note.)

Letters were sent by the Division of Serials and Exchanges of the University of California Library to the designated depositories, and without exception this plan received commendation. The librarian of one of the largest libraries in the eastern part of the United States wrote as follows:

> Your decision to print your serial publications on rag paper will, I hope, be imitated by other institutions publishing important serials and books. I know I need not tell you that those which have been printed on wood-pulp paper will have disappeared or become unusable within the next fifty years. So we applaud your decision and thank you most heartily for including us among the institutions to receive these rag paper editions.

This brief note of a project which should be of interest to all scholars and librarians must necessarily omit many details which might be of interest. But room is lacking for a detailed explanation.

It is unfortunate that we are not endowed with a Methuselah's term of life so that we may know whether our judgment is sound, but we are building

for posterity and hope that the record will be intact a thousand years from now.

SAMUEL T. FARQUHAR
THE UNIVERSITY OF CALIFORNIA PRESS

PROFESSIONAL SERVICES VS. "LABORATORY INDUSTRY"

THE object of this communication is to arouse all professional men, and especially scientists, to the dangers involved in the proposed "Code for Commercial Testing Laboratories," the title of which was changed to "Code for Commercial Research and Testing Laboratories." This change was the response of the code makers when it was pointed out that the wording of the proposed code was broad enough to include all professional men—chemists, engineers, physicists, psychologists, doctors, dentists, etc.—providing only that they maintain or operate any kind of a "laboratory" for the establishment of facts incidental to the practise of their respective professions.

Professional service is essentially a personal service and responsibility, generally demanding a confidential relationship to the client. It is against public policy to permit the professional man to hide his personal responsibilities behind the screen of incorporation. On the contrary, he personally is held to strict account not only by the law, but also by the code of ethics of his profession. He should be encouraged to establish his practise on the basis of his personal integrity and ability rather than to become an employee in some "professional" corporation, where the stockholders of to-morrow, if not those of to-day, may have interests opposed to those of the "clients" for whom work is done. All this is of the highest importance, for, once the individual professional man is under a "code," the Code Authority will have the right and duty under the enforcement rules to pry into his confidential records and thus often find items interesting to themselves or the corporations controlling their business. This destroys the chief protection the public has against possible deception by corporations.

In its broad sense, this proposed code appears to me to be an attempt on the part of industry to dominate the professions. Lawyers maintain libraries. Should they be included in a "library industry code"? Surgeons when operating may use a knife or a saw. Are they therefore to be included under the codes covering butchers and carpenters? A physician does not become a "Commercial Research and Testing Laboratory" when he makes blood, urine or other tests incidental to his practise. Neither does the professional chemist, when he makes the tests needed to guide him in forming his opinions and giving his advice to clients, or in giving his testimony in court.

The article printed on pages 341 and 342 of the issue of SCIENCE for April 13, entitled "A Code for Chemists?", fails to point out this major issue, although it lists six other reasons why professional scientific men oppose codification under NRA. So far as I can see, the four methods mentioned by the author (H. H. Bunzell, chairman, Code Committee "Organized Food Laboratories") as "ready to be put into operation" under the code proposed by his group, and which "may be unorthodox as codes go," are all forms of advertising, even though the suggested "bi-weekly news letters," with material of interest to manufacturers, are to serve "as a clearing house for new methods and improvements of old ones." Perhaps this is to give the publication the odor of scientific sanctity, for it appears otherwise useless. SCIENCE for February 16 states that last year 64,190 abstracts, covering the literature of the world, were published in *Chemical Abstracts* by the American Chemical Society. This enormous organization, with its 17,000 members making it the largest organization of all kinds of chemists in the world, has come out strongly against codification.

Dr. Bunzell states that in his group there are 75 or more independent food laboratories, most of them small, many with only a porter or office boy. He further states: "There is overwhelming evidence at hand that the food industries, still prosperous, in general consider laboratory work a luxury." The overwhelming evidence is precisely the opposite. Every important food industry maintains many laboratories, employs many competent chemists and runs its plants on the basis of ceaseless laboratory work. That is why comparatively little work is passed over to the outside "laboratory industry," which deals mainly with specialties and service to firms too small to have laboratories of their own. When the food industry was affected by the general business decline, there was naturally less work for outside laboratories.

Dr. Bunzell laments the fact that "the chemist is not rendered the same degree of recognition or business courtesy as his professional brothers, the legal adviser or the advertising counselor." Depending on their behavior and competence, the professional chemists I know are accorded the same recognition as members of any other ethical profession. Chemists employed in an industry come under the codes of their respective industries. There is no reason why a man trained professionally may not conduct or work for an industry. Professional chemists refuse to be thrust into the "laboratory industry" or any other industry.

So far as I can make out, the main sponsors of the proposed "Code for Commercial Research and Testing Laboratories" are certain corporations whose animus could very well be "more tests, higher prices and larger profits," instead of their ostensible slogan,

"more chemists employed." The evidence is "more chemists would be discharged." It is a question whether, under the proposed code, professional men in many fields may not be compelled to have their tests done by these corporations.

Last summer, in response to the President's appeal for cooperation, both the Association of Consulting Chemists and the American Institute of Chemists inquired of National Industrial Recovery officials how they might best cooperate, and whether professional codes, based primarily on codes of ethics (rather than the expediencies of business), were contemplated. After consideration, both organizations were informed that professional chemists and professional chemical engineers were not to be "coded." Therefore, when a code for commercial testing laboratories was proposed and discussed, the vast majority of professional men paid little or no attention to it. It was only when the letter of resignation of Arthur D. Little, Inc., was published that it became evident that into the "Commercial Testing Laboratory Code" there had been inserted wording of great danger to professions in general and to the chemical profession in particular. It is against public policy to allow incorporated testing laboratories controlled by public utilities and manufacturing corporations to dominate professional work.

JEROME ALEXANDER

NEW YORK, N. Y.

UNUSUAL STROKES OF LIGHTNING

LAST night (May 9, 1934) about one o'clock there was an occurrence which I believe is rather rare. In the course of a severe electrical thunderstorm lightning "struck" a tree about 100 feet from our house. The peculiar facts about the phenomenon are that it "struck" the same tree twice within about a second's time, and that the tree is a *dead* (walnut) tree, whereas within 75 feet of it, near our house, are two tall *live* Lombardy poplars. The old tree, about 50 feet tall and with a trunk close to 4 feet in diameter at its base, died several years ago, but had been left standing (it being in a vacant lot).

The lightning blasted off a layer of wood, a few inches to nearly a foot wide and two to three inches thick in pieces from a few inches to five or six feet in length from opposite sides of the tree from about twenty feet up to about two feet from the ground, hurling the pieces as far as a hundred feet from the tree. There was no searing or burning effect.

I have never heard of a case where lightning "struck" more than once so close to the same spot within so short a time.

E. P. WIGHTMAN

KODAK PARK
ROCHESTER, N. Y.

CLOCKWISE ROTATION IN PARAMECIUM TRICHIUM

As Wenrich[1] and others have pointed out, the rotation of all species of Paramecium except *P. calkinsi* is typically counter clockwise while swimming freely. Inasmuch as the clockwise rotation of *P. calkinsi* is one of the characteristics given by Wenrich as diagnostic for this species, the following observations may be of interest.

I have seen numerous specimens of *P. trichium* change the typical counter clockwise rotation for a clockwise one. The clockwise rotation may be for a few turns only or it may persist for some time. In no case, however, has the "abnormal" rotation been observed to persist for longer than about twenty-five complete rotations of the body. Often an individual will rotate counter clockwise for fifty or more turns of its body, change to a clockwise rotation for from three to ten turns, and then resume the counter clockwise rotation. Rarely, individuals reverse this process, temporarily turning clockwise more than counter clockwise. If one individual be watched for an hour or more the counter clockwise rotation is always seen to be the more frequent.

These observations were made upon organisms cultured in a standard hay infusion. The animals showed no sign of abnormalities.

ARTHUR N. BRAGG

ANDOVER, MASS.

THE "GUNS" OF SENECA LAKE

IN SCIENCE for April 13, Professor H. L. Fairchild explains the nature of certain mysterious muffled sounds or explosive noises long noted about or over Seneca Lake. These sounds, it may be said, are conclusively shown to be due to escape of gas from the deep Dundee gas area making its way through the glacial drift filling the bottom of the great canyon-like Tertiary river valley of central New York now occupied by the lake. As gas bubbles make their way upward, first through the drift and then through the deep water, heavy pressures are gradually released, and as the surface of the lake is reached the noises like those of muffled guns are heard. Although, exploitation in the Dundee field having greatly reduced the original pressure of 770 pounds per square inch, it is believed the ghost guns of the Seneca are about "silenced."

Is there not here seen a partial illustration of the nature of some of the mysterious sounds of the Yellowstone? Elsewhere I suggest a more physicochemic explanation. The conditions about the Yellowstone and Shoshone lakes producing sounds which vary from explosive blurts to highly musical pitches must be complex. That any one explanation may suffice is unlikely. But it would be of interest to know what the impressions gained from hearing the

[1] *Trans. Am. Micros. Soc.*, 47: 280, 1928.

sounds about the northern side of the Shoshone Lake in particular as compared with those of the Seneca Lake might be. As it turns out no one seems to have taken note from lake to lake. Awing and strange as these nature sounds are, there has long been a silence about them quite as strange as the sounds themselves.

G. R. WIELAND

YALE UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

APPARATUS FOR MOTOR CONDITIONING IN CATS[1]

A CONVENIENT apparatus for motor conditioning in cats and other small animals has long been needed. These animals being widely used for operative purposes, it is often desirable to establish conditioned responses in connection with the operative procedures. The lack of a convenient means of training has, however, made it inconvenient to use them in many cases for which they would otherwise be particularly suitable. For example, cats are commonly used in experiments on the middle ear, but hitherto it has been difficult to determine the actual effect of these operative changes upon hearing.

The lack of a suitable conditioning technique has also led to the wide-spread belief that cats are "stupid." This attitude was exemplified by a well-known investigator who, after years of operative work with cats, remarked informally that if cats were able to learn anything he had not yet found it out. It seems likely that this apparent stupidity is due far more to inadequacy of the training techniques employed than to the animal. Proceeding on this assumption, we recently devised an apparatus which seems to be well adapted to the normal action-patterns of cats.

The apparatus consists essentially of four grills composed of small copper bars, set in a radial, fan-wise arrangement; each grill thus constitutes one quadrant of a complete circle. The grills are separated by metal barriers 6 inches high; the animal can easily pass from any quadrant to the next and yet each one forms a distinct compartment. The ends of the bars extend well beyond the upright walls of the cylinder and are thoroughly insulated from each other and from the rest of the apparatus. Alternate rods are connected at the inner circumference and then joined to one pole of the source of shock. The other rods are joined to form the four individual sections. The four leads are joined to switches which connect with the other pole of the shock-potential. Closing any one switch, therefore, completes the circuit for the corresponding grill. The stimuli are presented automatically by a relay circuit so that the sound is "on" for an interval of about 2.2 seconds and is directly followed by a momentary shock on the grill which the animal is then occupying. The shock-intensity is readily adjusted by applying a high voltage (1,100 volts) across suitable resistors. The whole apparatus is covered with a removable wire-mesh lid; the cat is observed from outside the test-room through a mirror.

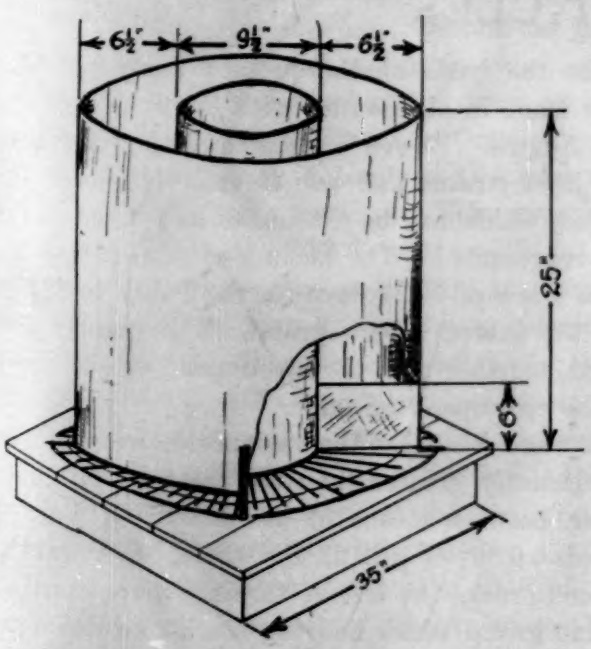

FIG. 1

In actual use, the animal is placed in any one of the quadrants. The stimulus-tone is presented and followed by the momentary shock, which is made just strong enough to stimulate the cat to move hastily over the barrier into the next quadrant. On the following trial, the cat again advances to another quadrant, and so on. The response required is thus as easy and natural as can well be imagined: merely moving into the section just ahead. At first the animal may prove slightly recalcitrant when shocked but soon reaches the stage of moving quickly and quietly ahead as soon as the tone begins.

We have used the apparatus for a number of months in conditioning cats and find that with 25 trials per day most cats will reach a score of 100 per cent. within from 7 to 14 days. This performance is fully equal to that of dogs who are conditioned to flex the right fore-paw upon presentation of a tone.[2] Cats promise to be particularly useful in auditory work, since they are perfectly quiet (no panting). Reliable limens can thus be obtained with minimal time and effort.

This apparatus was primarily devised for auditory stimulation, but by requiring the cat to make a com-

[1] Communication No. 6 from the Alpha Research Laboratory, Department of Psychology. Special aid from the Research Trustees of the American Otological Society and the Elizabeth Thompson Science Fund is gratefully acknowledged.

[2] SCIENCE, 78: 269–270, 1933.

plete circuit of the grill and thus return always to the initial position it may readily be adapted to other modes of stimulation (visual). We have not used it for training animals other than cats, but with minor modifications it should be eminently suited for any of the smaller species, such as guinea pigs.

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THE DETERMINATION OF MOISTURE IN UNSTABLE PRODUCTS

FOR the determination of moisture in relatively unstable products the vacuum oven is more dependable than the electrically heated and controlled drying oven, as is shown by the results obtained on six brands of commercial smoking tobacco and on the tobacco removed from five brands of cigarettes, all purchased in the local market. The samples were ground to pass a 1 mm sieve and the determinations conducted in glass-stoppered weighing bottles.

The vacuum oven employed was a water-jacketed Carr evacuated by an ordinary filter pump at room temperature (25° C.) with the intake air passed through sulfuric acid. The drying period for finely ground materials is generally over night (20 hours), but in this instance was continued through two nights, because of excessive humidity in the laboratory, followed by a single over-night run for the second weight. The electrical drying oven was of standard make and heated to 95° C. The drying periods were two, of 3 to 4 hours each, followed by an over-night run for the third weight.

MOISTURE IN TOBACCO SAMPLES

Sample No.	Vacuum oven		Electrical drying oven		
	Period 1	Period 2	Period 1	Period 2	Period 3
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Smoking					
1	4.65	4.76	6.17	6.64	7.37
2	5.81	5.93	7.21	7.80	8.90
3	4.99	5.11	7.38	8.28	9.52
4	4.87	4.98	6.13	6.34	6.72
5	5.52	5.64	7.31	7.92	8.83
6	5.61	5.70	7.52	8.39	10.01
Cigarettes					
7	4.82	4.95	6.52	7.05	8.04
8	4.50	4.65	6.46	7.07	8.11
9	5.37	5.51	7.33	7.91	9.01
10	5.49	5.59	7.10	7.49	8.56
11	5.79	5.90	7.67	8.23	8.99
Average	5.22	5.34	6.98	7.56	8.55

The slight additional loss on the second weighing from the vacuum oven could be attributed largely to quicker handling and to lower humidity. Decomposition was a serious factor by the electrical drying oven, even for the first period, and increased for the duration of the test. Similar results were obtained on ice-cream stabilizers.

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SPECIAL ARTICLES

HEREDITARY VARIATIONS IN THE GESTATION PERIOD OF THE RABBIT

FOR the past few years this laboratory has maintained an experimental colony of rabbits, comprising approximately 1,500 standard bred and hybrid animals. Each of the standard breeds has been inbred to a considerable extent in order to obtain a more homogeneous population than was represented by the original stock. In some cases close inbreeding has been maintained for several years. The data accumulated have included accurate records of the date of service and of birth of nearly all animals raised in the colony. Experience showed that the gestation period varied from 29 to 36 days. The data bearing on this subject have been submitted to a statistical analysis for the purpose of determining whether breed or race had any influence on the duration of pregnancy in the rabbit.

A total of 569 pregnancies from observed matings, distributed over a five-year period (1929 to 1933), forms the basis of the present analysis. Matings were made in all months, with the exception of July and August. Eleven breeds, consisting of ten standard bred strains and one intensively inbred line of albinos which may be considered as a breed or family, are represented. The mean gestation period ranged from a low of 30.37 days for the Polish to 32.89 days for the inbred albino group. The number in each breed, together with the breed mean values, are given in the accompanying table.

It was found that the variance between breeds was significantly greater than the variance within breeds (Var. between means of breeds = 10.09; Var. within breeds = 0.86; $F = 22.2$, $P = 0.01-$, significant). In order to make the test of variance more exacting, the albino group which had the longest gestation period, and which in reality is a family and not a standard breed, was excluded. On this basis, the variance between breeds, although reduced, was still significantly greater than the variance within breeds (Var. between

GESTATION PERIOD OF ELEVEN BREEDS OF RABBITS

Breed	n	Mean$_n$	σ_n	σMean$_n$	Coefficient of variation
		Days			%
Polish	26	30.37	0.57	0.11	1.88
Dutch	64	31.04	0.70	0.09	2.26
Havana	60	31.08	0.92	0.12	2.96
Himalayan	90	31.18	0.79	0.08	2.53
Chinchilla	29	31.42	0.83	0.15	2.64
English	64	31.41	0.85	0.11	2.71
Blue Beveren	51	31.46	1.01	0.14	3.21
Belgian	90	31.46	1.09	0.12	3.46
Flemish	14	31.79	0.92	0.25	2.89
American Blue	17	31.85	0.97	0.24	3.05
Albino	64	32.89	1.07	0.13	3.25
Total	569	31.45	1.08	0.05	3.43

means of breeds = 4.66, Var. within breeds = 0.76; F = 6.16, P = 0.01 –, significant). Not only were different gestation periods found for different breeds, but breeds closely related by origin or type, such as the Havana and Dutch, and the Belgian and English, had almost identical mean gestation periods, while comparatively unrelated breeds had widely different periods. The demonstration of heterogeneity between breeds is taken to indicate that with respect to the factor under consideration, each breed represented a homogeneous normally distributed population. Before concluding that the heterogeneity between breeds was the result of hereditary factors, certain environmental influences which might account for the differences found were considered.

All animals received the same diet and were housed indoors under uniform conditions. Seasonal factors at the time of mating did not influence the gestation period, since a significant difference was not noted between the mean values calculated from all matings in the two intervals from March to October and from November to February (March to October: n = 295, $M_n = 31.51 \pm 0.07$; November to February: n = 274, $M_n = 31.39 \pm 0.06$; D = 0.12 ± 0.09, t = 1.3, not significant). Moreover, the variance within two-months intervals was larger than the variance between two-months intervals, although the difference was not significant (Var. between means of two months classes = 1.55; Var. within two months classes = 2.81; F = 1.81, not significant). The indication is that with respect to season the population was apparently homogeneous and normally distributed.

The mean age of the doe at the time of mating ranged from 9.96 months for the American Blue to 14.75 months for the Chinchilla. The method of analysis of variance gave significant evidence that, as far as age of the doe at the time of mating was concerned, the whole set of values represented a homogeneous population (Var. between means of breeds = 5.91, Var. within breeds = 45.64; F = 7.72, P = 0.01 –, significant). There was no correlation between the breed mean gestation period and the breed mean age of the doe at the time of mating ($r_{xy} = -0.156$, not significant).

Body weight appeared to have some relation to the duration of pregnancy. In general the lighter breeds, such as the Polish and Himalayan, had shorter mean gestation periods than the heavier breeds, such as the American Blue and Flemish. This relationship was not constant, since the gestation period of the comparatively small English was the same as that for the heavier Beveren. However, when the breeds were divided into two classes according to weight, the gestation period of the heavier group was significantly longer than that for the lighter group (D = 0.48 ± 0.097, t = 5.01, P = 0.01 –, significant). This calculation excluded the heavy albino group with its long gestation period in order to make the test more critical.

There is some evidence that the duration of pregnancy is related to the size of the litter, for a probably significant correlation was found between breed mean values for the gestation period and litter size ($r_{xy} = +0.708$, P = 0.03 –, probably significant). When the albino group was included in this calculation, no significant relationship was present. It is also an observed fact that for any given breed the gestation period is longer for small than for large litters. This inverse relationship within a breed between gestation period and litter size is indicated by a significant negative correlation for the eleven breeds, as calculated by the method of transformed correlations ($r_{xy} = -0.3004$, P = 0.01 –, significant).

Between breeds prolonged gestation periods were associated with large litters and short gestation periods with small litters. In marked contrast to this, within any given breed prolonged gestation periods were associated with small litters and short gestation periods with large litters. These findings were statistically significant and not due to a random association of the variables concerned. However, since the environmental factors of housing, feeding and season, and age of the doe could not account for the observed heterogeneity between breeds, it was concluded that unless some unknown environmental condition or conditions were operative, the differences in the gestation period of different breeds were dependent on hereditary factors.

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RELATION OF CAROTINOID PIGMENTS TO SEXUAL REPRODUCTION IN PLANTS[1, 2]

WHEN certain typical plants, such as Cosmos (*Cosmos bipinnatus*), Salvia (*Salvia splendens*) and soybeans (*Soja max*) are exposed to a short photoperiod (7- to 8-hour day) and a relatively long one (14- to 15-hour day) they exhibit conspicuous differences in rate of growth, time of sexual reproduction and greenness of foliage. The short-day soybean plants, for instance, are lighter in color early in their development, but soon match with the long-day plants and, during the period of reproduction, become intensely green. Since the color of the foliage is due primarily to chloroplast pigments, a survey has been made during the past 3 years of the concentration of chlorophyll (α and β), carotin and xanthophyll in various parts, but mainly leaves, of these plants.[3]

The results of a large number of determinations show that in the leaves of both short- and long-day group of Cosmos, Salvia and Soja approximately the same concentration of chlorophyll is present, but plants that have changed from vegetative development to the reproductive state have an increased carotin and xanthophyll content, as the following records show:

	Milligrams in 10-gram sample of leaves		
	Chlorophyll (α and β)	Carotin	Xanthophyll
Cosmos			
Vegetative (long day) ...	20.0	0.95	1.5
Reproductive (short day)	20.0	1.17	1.85
Salvia			
Vegetative (long day) ...	25.8	1.85	2.50
Reproductive (short day)	25.0	2.07	2.80
Soja			
Vegetative (long day) ...	22.7	1.10	1.52
Reproductive (short day)	22.1	1.49	2.00

Moreover, the concentration of the two carotinoids seems to reach a maximum at the time of flowering and then decreases. This is illustrated by reproductive (short-day) soybean plants, var. Biloxi.

	Carotin and xanthophyll in leaves of soybeans
	Milligrams in 10-gram sample
Vegetative (long day) plants	
Carotin	0.32 → 0.46 → 0.65 → 0.76
Xanthophyll	1.1 → 1.96 → 1.57 → 1.25
Reproductive (short day) plants	*Flowering*
Carotin	0.35 → 0.43 → 1.26 → 1.07
Xanthophyll	1.2 → 2.1 → 2.44 → 1.77

The exact meaning of this phenomenon and its bearing on the metabolism of plants is unknown at present. There is, however, a suggestive analogy in animals. The carotinoids are present in conspicuous quantities in various organs and secretions associated directly or indirectly with reproduction (corpus luteum, egg yolks, milk, etc.[4, 5]). Furthermore, it has been observed that these yellow pigments move from certain parts of the body to the reproductive organs, as in the case of some breeds of domestic fowl, dairy cattle, etc.

The now well-established relation of carotin, and possibly xanthophyll, to vitamin A, may be but one, though important, phase of the metabolic function of the carotinoids. Are they, especially carotin, merely "provitamins" for the formation of vitamin A or have they some other important activity in sexual reproduction of both plants and animals? The premonstration which seems to indicate that predominantly more yellow pigments are present in female than male plants of dioecious species (*Rhamnus*) or races (*Mucor*)[6] is interesting evidence having a bearing on the possible physiological rôle of these substances.

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[1] Contribution from the Department of Horticulture, Missouri Agricultural Experiment Station. Journal Series No. 381.

[2] A phase of an investigation supported by funds from the Committee on Effects of Radiation upon Living Organisms of the National Research Council.

[3] Separation and purification of all three pigments was conducted according to Willstätter and Stoll's method as modified by Dr. F. M. Schertz, of the U. S. Bureau of Chemistry and Soils, to whom the writer is indebted for cooperation in this work and the supply of pure chlorophyll, carotin and xanthophyll.

[4] L. S. Palmer and C. H. Eckles, *Mo. Agr. Exp. Sta. Res. Bul.*, 9, 10, 11 and 12, 1914.

[5] A. F. Blakeslee, *et al.*, *Conn. Agr. Exp. Sta. Bul.*, 92, 1917.

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